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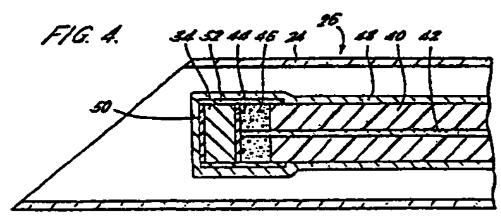
(54) **Device for use in the cannulation of blood vessels.**

(57) A device for use in the cannulation of blood vessels comprises a trocar 26 which is positionable within a hollow needle 24. The trocar comprises a support rod 40, an ultrasonic transducer 34 supported at one end of the rod for transmitting and receiving ultrasonic waves and electrical conductors 42 and 48 associated with the rod 40 for transmitting electrical signals to and from the transducer 34.

FIG. 4.



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Description

DEVICE FOR USE IN THE CANNULATION OF BLOOD VESSELS

This invention relates to a device for use in the cannulation of blood vessels.

Insertion of arterial and venous catheters for angiography and acute care of patients is a major source of discomfort, morbidity, and even mortality. The problem of accurate location and penetration of arteries and veins is especially acute for patients who may be obese or present an unusual anatomy and who are undergoing cardiac catherization and other radiological procedures such as cerebral angiograms.

The potential utility of Doppler ultrasound for accurately guiding a needle into a vessel has been recognised. Most applications utilize the transmission of ultrasonic waves through the needle and reception of ultrasonic echos by a separate transducer located on the body of the patient and separate from the syringe and needle. Such applications obviously have limited accuracy. U.S. Patent Specification No. 3,556,079 entitled "Method of Puncturing a Medical Instrument Under Guidance of Ultrasound" discloses in one embodiment the placement of both transmitting and receiving transducers in the needle and syringe. Such an embodiment, however, requires a special catheter construction and can give an erroneous signal when the needle engages the blood vessel before penetrating the vessel.

The invention provides a device for use in the cannulation of blood vessels comprising a trocar which is positionable within a hollow needle, the trocar comprising a support rod, an ultrasonic transducer supported at one end of the rod for transmitting and receiving ultrasonic waves, and electrical conductors associated with the rod for transmitting electrical signals to and from the transducer.

In the accompanying drawings:

Figure 1 is a schematic representation of a needle being inserted into tissue for cannulation of a blood vessel;

Figure 2 is a plot of Doppler signal intensity versus distance in tissue of the needle in Figure 1;

Figure 3 is a perspective view illustrating a cannulation device;

Figure 4 is a section view of one needle portion and trocar portion;

Figure 5 is a section view of another needle portion and trocar portion; and

Figure 6 and Figure 7 are section views of portions of different trocars.

Figure 1 is a schematic illustration of a needle and syringe assembly 10. The assembly 10 includes a needle 12 and a syringe portion 14 with an ultrasonic transducer within the syringe portion 14. Wires 16 are electrically connected with the transducer for the transmission and reception of electrical signals. In the drawing, the needle 12 is being inserted through tissue 18 towards a blood vessel 20.

As the needle 12 is passed through the tissue 18, the tip of the needle is moved in a slight arc for directing ultrasound energy transmitted through the needle to the vessel 20. The returned echo signal is used for accurately guiding the needle 12 to the vessel 20 and may provide an indication of when the needle penetrates the vessel 20.

Figure 2 is a plot of the intensity of the Doppler signal against the depth within the tissue 18. When the needle 12 is first inserted into the tissue 18 but not directly towards an artery or vein, the response is small and relatively flat as indicated. Upon pointing the needle 12 at an artery an increased modulated wave is detected; conversely, when the needle is point towards a vein, an increased generally uniform signal is indicated. Actual penetration of the vessel will be indicated by the back flow of blood when the vessel is pentrated by maintaining a negative pressure in the needle and a constant back pressure on the syringe while the needle is being advanced. Once the vessel is penetrated, brisk backflow of blood in the needle indicates safe penetration of the vessel and can cause the stepped increase in reflected wave intensity thereby indicating a safe location for injection of medications or passage of a wire into the vessel.

Figure 3 shows a device for use in the cannulation of blood vessels which includes a needle portion 24, shown in section view to illustrate a trocar 26 therein. The needle and trocar are connected to a syringe 28 by means of a connector 30. Electrical wires 32 are connected through the trocar with an ultrasonic transducer 34 at one end of the trocar. The transducer 34 is positioned at the sharp end of the needle 24 for the transmission and reception of ultrasonic energy through the open end of the needle.

Figure 4 is a section view of a portion of the needle 24 and the trocar 26 further illustrating the construction of the trocar. The trocar 26 includes a plastics support rod 40 through which a first electrical conductor 42 extends into contact with an electrode 44 on the back surface of the transducer 34. The transducer 34 is affixed to the support rod 40 by means of a low acoustic impedance epoxy 46 which is filled with glass microballoons. A second electrical conductor 48 is formed on the exterior surface of the support rod 40 by means of metal deposition and extends into contact with an electrode 50 on the front surface of the transducer 34. An insulative material 52 such as an epoxy is formed around the periphery of the transducer 34 to electrically isolate the electrode 44 on the back surface from the conductor 48 connected to the electrode 50 on the front surface. The transducer 34 is positioned near the sharp end of the needle 24 for the transmission and reception of acoustic energy through the opening in the needle.

In Figure 4, the trocar 26 has an outer diameter less than the inner diameter of the needle 24 whereby blood flow, upon penetration of a blood vessel, is accommodated around the trocar.

Figure 5 is a perspective of a trocar 56 in which the trocar is in contact with the inner surface of a needle 58. The electrical conductor on the outer surface of the trocar physically and electrically contacts the needle 58, and the needle then functions as one electrode in transmitting energy to a transducer 60 attached to the trocar by an acoustic energy absorbing epoxy 62. Blood flow is accommodated by a central tubular portion 64 of the trocar.

In Figure 6 a support rod 68 is provided for supporting a transducer 70 and a backing epoxy 72. Two separate conductors 74 extend through the support rod 68 with one conductor contacting the back electrode of the transducer 70 and the other conductor extending through the transducer and contacting the front electrode. Where the second electrode passes through the transducer 70, insulation must be provided to electrically insulate the conductor. Again, insulation 76 is provided on the outer surface of the transducer 70, backing material 72 and support rod 68 to electrically isolate the back electrode from the front electrode.

Figure 7 shows a construction similar to the construction of Figure 6, and the same reference numerals are applied to like elements. One electrode 74 extends through the support rod 68 and the backing material 72 to contact the back electrode of the transducer 70. The other electrode 74 is plated on the exterior surface of the support rod 68 and contacts the front electrode of the transducer 70.

In one construction the following materials were employed:

Support rod - 18 gauge stainless steel tubing.
Backing material - Emerson IG0101 microballoons in epoxy.
Transducer - PETSA, 1mm diameter, 20 MHz.
Insulation Material - Ablestix 931-1 epoxy.
Electrical Conductive Material - Trabond 2902 silver epoxy.

The device for use in the cannulation of blood vessels as described above is readily utilised in the Seldinger technique for blood vessel cannulation. After the needle is inserted and guided to a vein by the Doppler technique, the vein is penetrated as indicated by the back flow of blood through the needle to the syringe portion. The syringe is then removed from the needle and the connector, and the trocar is then removed from the needle. A wire is placed through the needle into the vein, and the needle is then removed. Finally, a prosthesis is guided into position in the vein by the wire and the wire is then removed.

The transducer can be attached directly to the support rod without the use of damping material.

Claims

1. Device for use in the cannulation of blood vessels comprising a trocar (26;56) which is positionable within a hollow needle (12;24;58), the trocar comprising a support rod (40;68), an ultrasonic transducer (34;60;70) supported at one end of the rod (40;68) for transmitting and receiving ultrasonic waves, and electrical conductors (16;32;42;48;74) associated with the rod (40;68) for transmitting electrical signals to and from the transducer (34;60;70).

2. Device as claimed in claim 1, and further including a hollow needle (12;45;58) having a sharp end for penetrating tissue and a syringe portion (14;28) detachably attached to the needle, the trocar (26;56) being positioned within the needle.

3. Device as claimed in claim 1 or 2, wherein the electrical conductors include a wire (42;74) which extends through the support rod (40;68) and is in contact with one surface of the transducer (32;70), and a metal conductor (48;74) which is on the surface of the rod and is in contact with another surface of the transducer.

4. Device as claimed in claim 1 or 2, wherein the electrical conductors include two wires (74) which extend through the support rod (68) with one wire contacting one surface of the transducer (70) and the other wire containing another surface of the transducer.

5. Device as claimed in any preceding claim, wherein the transducer (32;70) has metal contacts (44,50) on its surfaces contacting the electrical conductors (42,48;74).

6. Device as claimed in any preceding claim, wherein the transducer (34;60;70) is attached to the one end of the support rod (40;68) by means (46;62;72) which includes an ultrasonic damping material.

7. Device as claimed in claims 2 and 3, wherein the metal conductor (48;74) contacts the needle (12;45;58) whereby the needle comprises a portion of the conductor.

8. Device as claimed in any preceding claim, wherein the support rod (40;68) includes a passage (64) for the back flow of fluid.

9. Device as claimed in claims 2 and 3, wherein the support rod (40;68) and the metal conductor (48;74) are spaced from the needle (12;45;58)

FIG. 1.

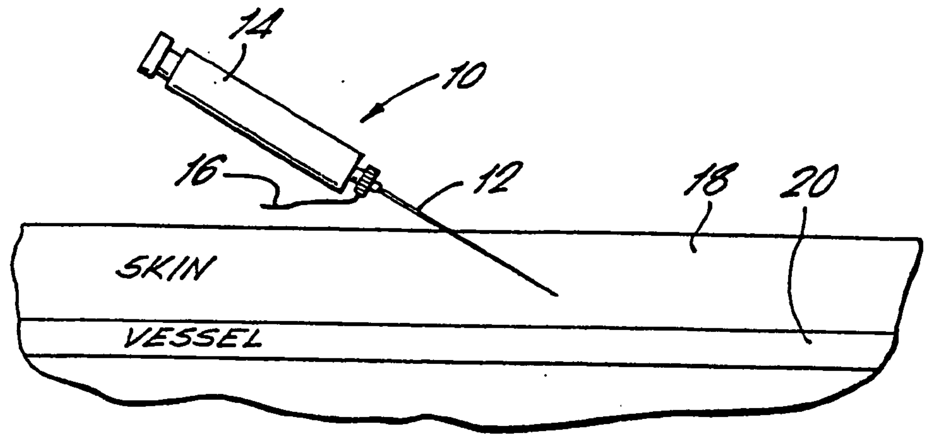


FIG. 2.

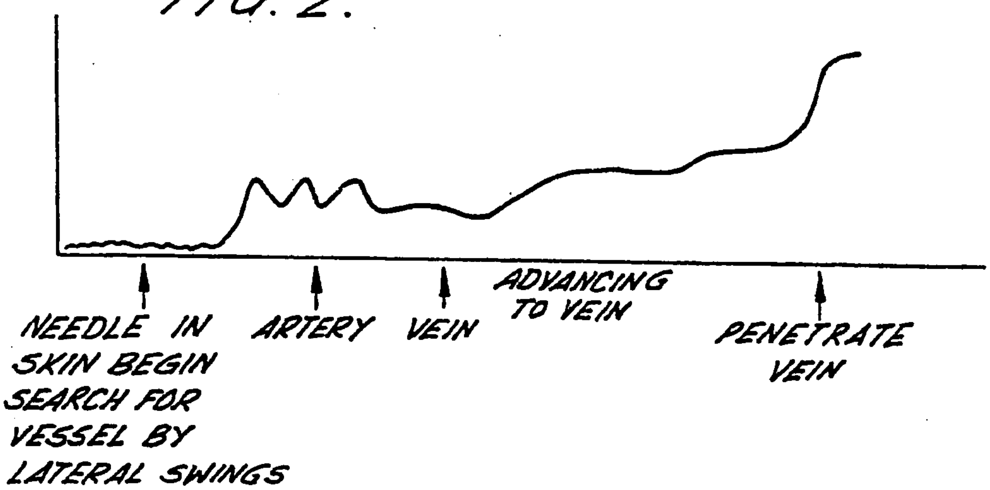


FIG. 3.

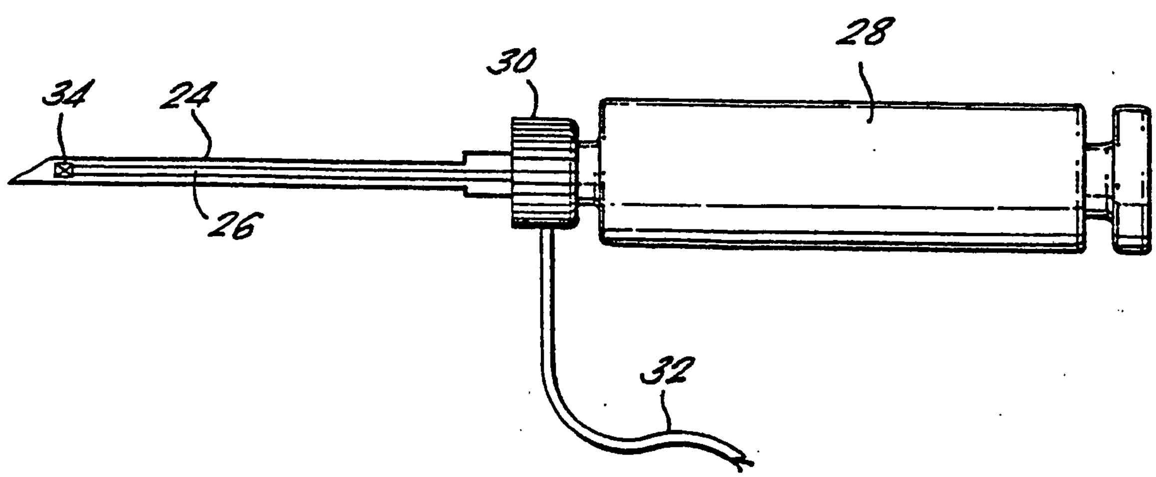


FIG. 4.

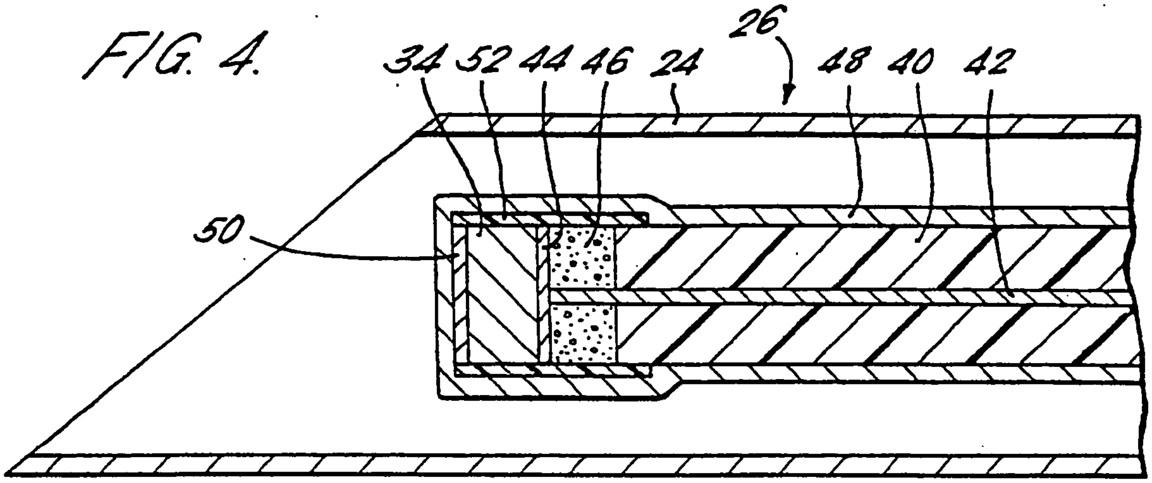


FIG. 5.

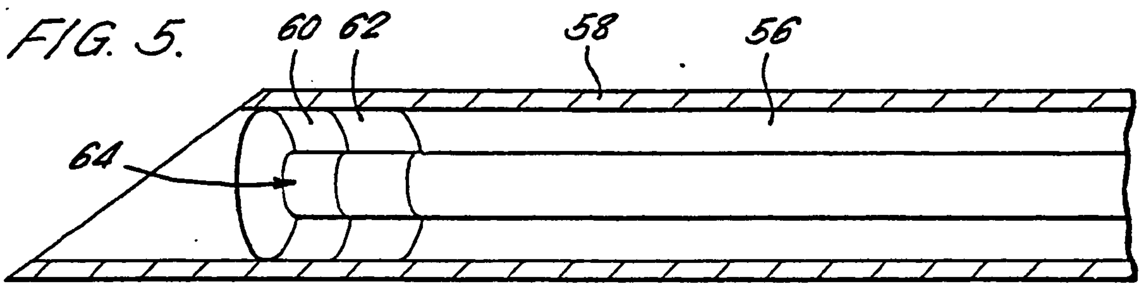


FIG. 6.

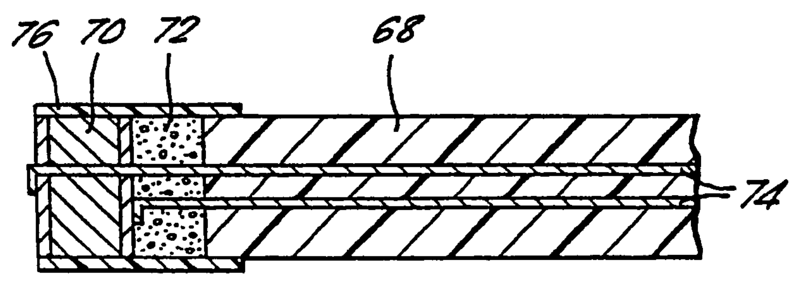
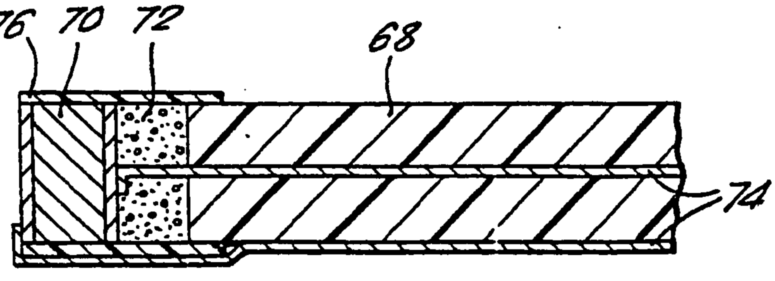


FIG. 7.



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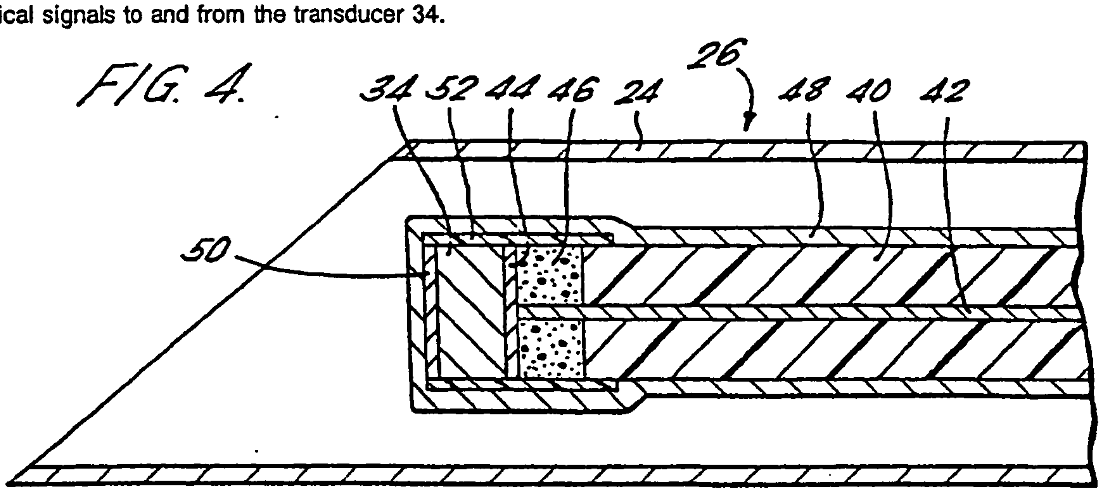

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EUROPEAN SEARCH REPORT

Application Number

EP 87 30 8198

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	GB-A-2 157 828 (LESNY et al.) * Page 2, lines 29-59; figures 1-3 * ---	1-9	A 61 B 17/34
Y	FR-A-2 555 432 (FRANCESCHI) * Claims 1-4 * ---	1-9	
A	EP-A-0 217 689 (ALVAR ELECTRONIC) * Abstract * ---	1-9	
A,D	US-A-3 556 079 (OMIZO et al.) ---	1-9	
A	FR-A-2 252 582 (AKADEMIET FOR DE TEKNISKE VIDENSKABER SVEJSECENTRALEN) * Figures 1-3; claim 1 * ---	1,2,8	
A	US-A-4 249 539 (VILKOMERSON et al.) * Column 2, line 46 - column 3, line 8 * -----	1,8	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			A 61 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-01-1989	RAKOWICZ,J.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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